FLIGHT

First Aero Weekly in the World.

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport.

OFFICIAL ORGAN OF THE AERO CLUB OF THE UNITED KINGDOM.

No. 57. (No. 5, Vol. II.) | JANUARY 29, 1910. | Registered at the G.P.O. as a Newspaper. | Weekly, Price 1d. Post Free, 1½d.

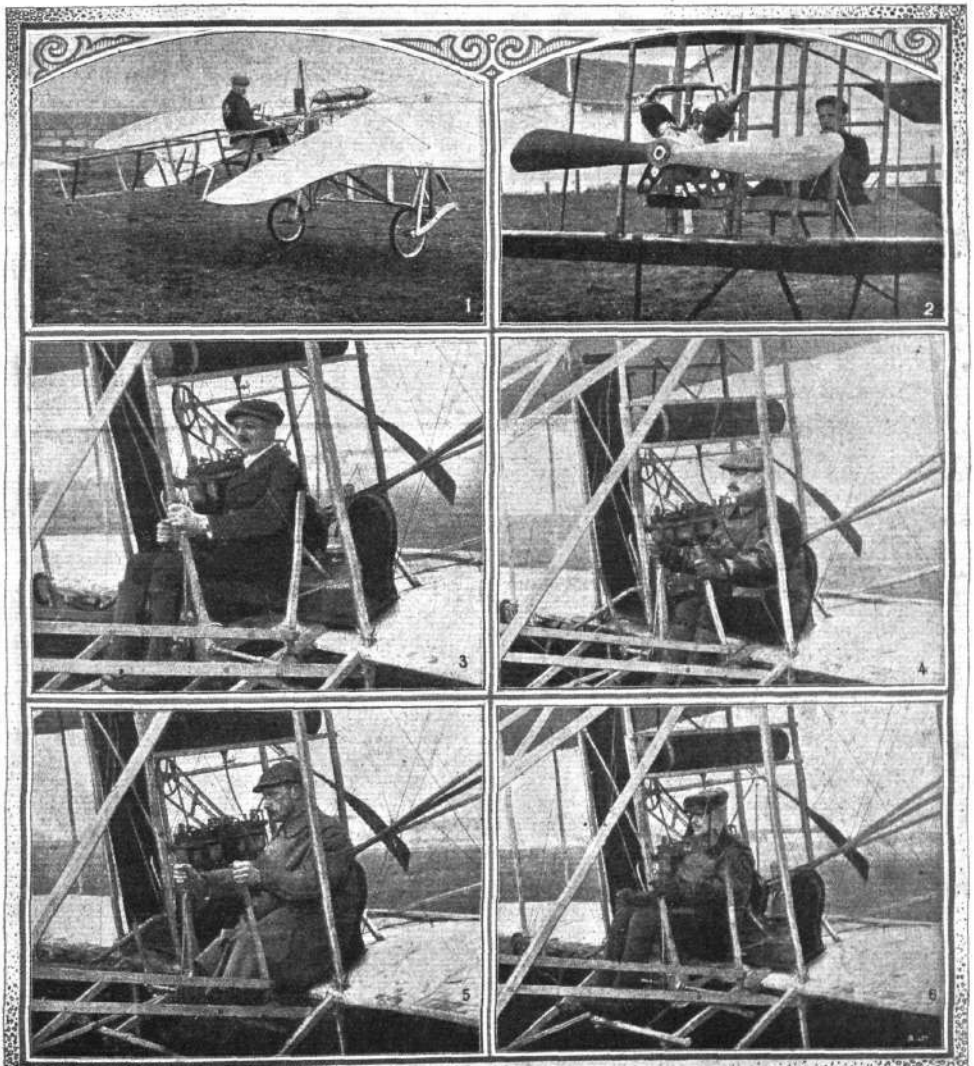

Photo by *Automobil Welt.*

GERMAN FLYERS.—(1) The Gebr: Timm monoplane; (2) the Hanuschke biplane; (3) Thaddäus Robl; (4) Paul Lange; (5) Engineer Thelen in his Wright machine; (6) Fridolin Keidel, the instructor at the German Wright Company.

AEROPLANES AND THE LAW.

By A BARRISTER-AT-LAW.

THE legal position of a flying man is a matter which may well provide food for reflection to the contemplative lawyer. At present, of course, there is no suggestion of legislative interference with those who have solved the problem of flight. Whether our common law is sufficiently elastic to solve the many legal problems which must arise in this connection is by no means an unattractive problem.

Take, first, the question of trespass. How far is a man who flies over another's land guilty of, and liable for, trespass? That he commits a trespass there can be no doubt; for the owner of the soil is owner *usque ad cœlum*. It has often been held that to string wires, or allow your trees to branch forth over the land of another, is a form of trespass which can be restrained by injunction. It has also been decided that to fire a rifle across a neighbour's field is an interference with his rights, although both rifle and target are without his boundaries. Finally, to come somewhat nearer to the matter in hand, it is of record that, in 1817, a judge of the High Court declared it to be a trespass to cross the land of another in a balloon. True it was but an *obiter dictum*, which, in the words of an old judge "is a gratuitous opinion, an individual impertinence which bindeth none—not even the lips of him that utters," but it is a declaration of what seems to be good law.

It may be assumed, then, that an aeroplanist who passes over my land can be served with a writ—if he can be caught; that he may have to compensate me—if he has caused any damage; and that he may be restrained by injunction from repeating the offence. But what damage accrues, if nothing is dropped from the aeroplane? He who seeks damages at the hands of a jury must prove loss. If he can prove no loss sustained, the only financial result of his case would be a bill of costs—payable by himself.

It is clear, however, that there are certain kinds of trespass for which the flying man may be held responsible, when the field of his operations becomes more enlarged than it is at present. He may not be able to choose his landing place to a nicety. He may injure a garden or a field of corn. He may damage a roof, or run foul of telegraph wires. In all such cases the injured party could hold him responsible. Finally he—or his machine—may "fall upon a liege subject using the highway" to the prejudice of such person. In all these cases the liability of the flyer would be clear; and it would be no excuse for him to say that his machine had got out of hand, or that he had been overturned by a sudden gust of wind.

As the aeroplane is still in its infancy, flights o'er moor and mead are not yet frequent. As a rule, the driver is content to exhibit his prowess over some definite tract such as is afforded by a strip of hard sand or a racecourse. Suppose he were to fall, with his machine, into the midst of a crowd which had assembled to see him. Would anyone injured in such a catastrophe be entitled to sue him or the owners of the "aerodrome"? It is submitted that the answer to the question should be in the negative, if the injured person had paid to enter a particular enclosure in order to view the flight. In going to such a place a man must be deemed to have undertaken a certain risk of accident. It would be otherwise, of course, if at the time of injury, the person injured was walking in some public place where he had a right to be. He could then bring suit against the aeroplanist for trespass.

Having dealt with the rights of the public in relation to the modern form of aeronautics, it may be well to consider the rights of those who buy and sell aeroplanes. What, for instance, will amount to breach of warranty on the sale of a machine of this description? What warranty would be given? Using the jargon of the horse dealer, the vendor of an aeroplane might warrant it "sound *in wind*," but he would have to add, "if driven by a competent driver." Again, would the purchaser demand a trial run before he paid his money? A trial run in a motor is one thing; if the engine stops there is no great harm done. But if the motor of an aeroplane stops, or the elevating planes go wrong, there is one bump, and all is over. If the would-be purchaser survives, the wreckage on the ground is the condemnation of the machine which he thought of buying.

This illuminating discourse may be continued a little longer. What shall be the "rule of the air"? If there is a collision "in the blue" who shall be held blameworthy?—assuming, for the moment, that both victims of the disaster are alive to tell their conflicting stories of what occurred. The assumption may be a wild one; but the case will arise some time during the next fifty years. Here the legal nose will scent a nice point of law. In all probability, at the time of the collision, both parties will have been trespassers upon or over the land of some third person. What right had either party to be where he was when the calamity overtook him? These and many other pretty questions must be at large until the parties can refer to the "statute in that case made and provided" for light and leading.

Lastly, what place will the aeroplane find among the unwritten canons of International law? It is obvious that if heavier-than-air machines ever do become practical means of transport for men and materials, the whole face of modern warfare will be completely changed. Frontier guards will be powerless to prevent invasion; insularity will no longer avail against Continental armies. So long as the flying man remains the sport of every wind, he can be of but little use as a military unit, for although he may land in the enemy's country, he must wait there until the wind changes. The controllable aeroplane, however, may be a most effective scouting machine.

With these few words we must leave the International aspect of flight for the consideration of those who assemble together at the next Peace Conference at the Hague.

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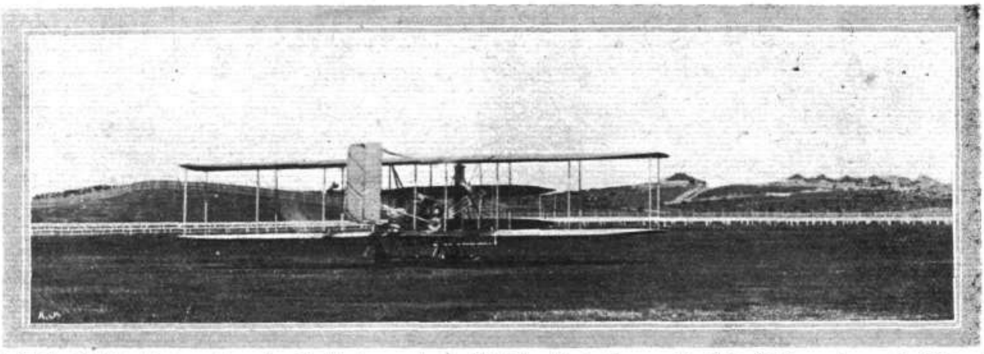
Aeronautical Classics.

A USEFUL work which has just been undertaken by the Aeronautical Society is the publication of a series of books, of which the originals are very rare. They will be issued at intervals during 1910, will be fully illustrated, and contain biographical notices of the various authors and their most important writings on aeronautical science. The first two, those dealing with Sir Geo. Cayley and Mr. F. H. Wenham, will appear in March, and the others will probably be issued in the following order: 3. Thos. Walker; 4. Stringfellow, Pilcher, and Lilienthal; 5. Francis Lana, 1670; 6. Leonardo da Vinci. No. 5 will contain the writings on flight matters by that pioneer, which have been specially translated for the first time for this series. The price of each volume will be 1*s*.

FLIGHT PIONEERS.

MR. A. V. ROE.

FIRST FLIGHT IN AUSTRALIA.



Mr. Colin Defries just starting for the first aeroplane flight in Australia, on his Wright flyer, from the Victoria Park racecourse, Sydney, N.S.W., on December 9th last.

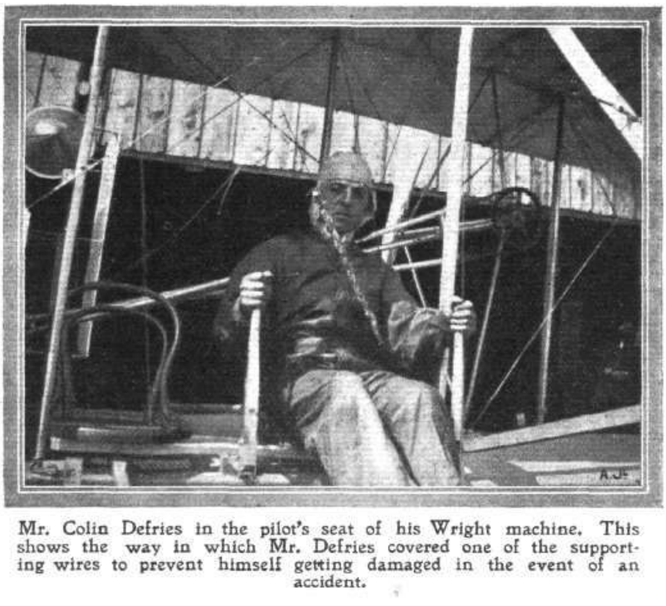
ON December 9th, at the Victoria Park Racecourse, Sydney, N.S.W., Mr. Colin Defries, as we recorded at the time, accomplished the first flight ever made on an aeroplane in Australia, although a heavy S.W. gale was blowing at the time.

Further particulars and photographs are now to hand from Mr. D. C. Defries, the young aviator's—he is twenty-five years of age—father. The aeroplane—a Wilbur Wright—which was mounted on a superstructure carried on three pneumatic wheels (instead of going off from the starting platform usual with these machines), rose to a height of about 35 ft., and covered about a mile in $1\frac{1}{4}$ mins., when the aviator had to come to earth as the motor was performing badly, due, it was found, to faulty sparking-plugs.

The event created a lot of excitement, and there was a large crowd on the ground.

On the following day another short flight was accomplished, when Mr. Defries took up a passenger—Mr. C. S. Magennis, a well-known Australian mining engineer—and although a long flight was again impossible on account of the engine not running perfectly, enough was done to prove his complete mastery of the aeroplane.

Mr. Colin Defries was educated at St. Paul's College, at Darmstadt, and University College, London, and received his practical engineering training at the works of Messrs. Bruce, Peebles, and Co., Edinburgh. Previous to going to Australia, where he is sole agent for several well-known motor cars, he had made a considerable reputation in the motor world, and amongst other races drove in the Grand Prix and Kaiserpreis in 1907, and on each occasion was the only Englishman who finished.



Mr. Colin Defries in the pilot's seat of his Wright machine. This shows the way in which Mr. Defries covered one of the supporting wires to prevent himself getting damaged in the event of an accident.

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AeC.F. Pilote-Aviateurs.

UP to date, the Aero Club of France have issued twenty-eight pilote-aviateur certificates, as per the following list, which gives the number of the certificates and the name of the machine on which the qualifying flights were made :—

1. Blériot (Blériot); 2. Curtiss (Curtiss); 3. Delagrange (Voisin), since deceased; 4. Esnault-Pelterie (R.E.P.); 5. H. Farman (Henry Farman); 6. M. Farman (Maurice Farman); 7. Gobron (Voisin); 8. De Lambert (Wright); 9. Latham (Antoinette); 10. Paulhan (Voisin); 11. Rougier (Voisin); 12. Santos-Dumont (Santos-Dumont); 13. Tissandier (Wright); 14. O. Wright (Wright); 15. W. Wright (Wright); 16. D. Bunau-Varilla (Voisin); 17. Leblanc (Blériot); 18. Mamet (Blériot); 19. Métrot (Voisin); 20. Prince Bibesco (Blériot); 21. Aubrun (Blériot); 22. Balsan (Blériot); 23. Rolls (Wright); 24. Mortimer Singer (H. Farman); 25. Molon (Blériot); 26. Brégi, Henri (Voisin); 27. J. de Lesseps (Blériot); 28. C. Grahame-White (Blériot).

It will be seen that nine were secured on Blériot machines, seven on Voisin, five on Wright, two on Henry Farman, and one each on Antoinette, Curtiss, R.E.P., Santos-Dumont, and Maurice Farman.

DESIGN AND CONSTRUCTION OF AEROPLANES.

By J. P. CHITTENDEN and L. H. ROBINSON.

(*Concluded from page* 59.)

THE great difference between the actual and theoretical lift of an arched plane or aerocurve can only be explained by the assumption that a slight reduction of pressure must occur behind the hump on the upper surface of the plane; this can be proved to a certain extent by taking a thin sheet of semi-flexible material and bending it into an arched form. If a current of air is allowed to pass along the top side, it will be noticed that the back edge has a tendency to lift. It is held by some that this action does not take place, and the stream lines follow the contour of the surface, but considering the simple experiment given above, it seems probable that the former assumption is more correct. Then the total lifting surface

$$= \frac{\text{total weight of machine}}{P}.$$

Dividing the result obtained by the aspect ratio will, of course, give the necessary dimensions for the planes. The theoretical horse-power to drive a given plane through the air is obtained from the formula: $\text{h.p.} = \dfrac{\text{total weight of machine} \times \tan \alpha \times V \text{ in m.p.h.}}{375}$

To this must be added the skin friction of the plane, which is generally taken to be about ·009 for speeds of from 30 to 40 miles per hour. Apart from losses due to skin friction of the planes themselves, there are also appreciable losses due to struts, wires, &c., owing to the wind pressure against these parts. To find the value of these losses, it is necessary to determine the wind pressure due to a given speed. In the simple case, when a stream of air of finite cross section impinges normally on a flat surface, the area of the surface being considerably greater than that of the stream, the pressure per sq. ft. $= \dfrac{W v^2}{g}$, or expressed in miles per hour, substituting $v = 1{\cdot}466\,V$, then $P = \dfrac{0{\cdot}0807 \times 1{\cdot}466^2 \times V^2}{32{\cdot}2} = {\cdot}0054\,V^2$.

Now, in the case of a strut or an exposed beam, the section of air stream is greater than the surface on which it impinges, so that the change of direction of the air stream is not complete, and it has been found by recent experiments that an average value of P may be taken as equal to $0{\cdot}0036\,V^2$.

The above remarks apply only to flat surfaces, and by using more suitable sections, such as *b* or *c*, in Fig. 7.

Too much care cannot be taken to reduce the resistance of parts as much as possible, and all uncovered members should be designed with this in view.

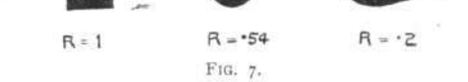
Taking the resistance of a flat surface R = 1 (*a*),
then for a cylindrical section R = ·54 (*b*),
and for an ichthyoid section R = ·2 (*c*).

So that the horse-power absorbed by the resistance of these exposed parts may now be obtained by the formula:

$$\text{Horse-power absorbed} = \frac{A \times {\cdot}0036\,V^3 \times R}{375}$$

where A = area of section exposed to wind pressure,
V = velocity in miles per hour,
R = value for shape of section.

By combining these results, the total horse-power required is arrived at, but in practice it has been found advisable to increase



R = 1 R = ·54 R = ·2

FIG. 7.

this amount, as a considerable surplus of power is advantageous to meet those emergencies which occur in actual flight.

Below is given a table of some well-known aeroplanes, with particulars of weight, surface, aspect ratios, &c.

Before leaving the subject of planes, the position of the centre of pressure of the plane in relation to the centre of gravity should be considered, as the balance of the machine in the air is dependent upon this. The position of the centre of pressure of the plane varies slightly with the shape of the plane and the angle of incidence. The position of this point is a matter of experiment, but with an angle of about 5° it is approximately at ·2 of the length of the section from the front edge and increases gradually to ·35 with an angle of 20°.

To ensure perfect balance of the machine, the centre of gravity should coincide with the centre of pressure of the plane at

TABLE I.

Machine.	BIPLANES.					MONOPLANES.				
	Wright.	Farman.	Voisin.	Curtiss.	Cody.	Blériot.	Blériot.	R.E.P.	Santos Dumont.	Antoinette
Surface of main plane in sq. ft.	540	430	445	250	850	150	240	220	115	365
Weight of machine (total) in lbs.	1000	1200	1310	700	2200	750	1200	1000	392	1100
Ratio W/S = lbs. per sq. ft. ...	1·85	2·8	2·95	2·8	2·58	5	5	4·5	3·4	3·02
Span in ft.	41 ft.	34 ft. 6 in.	32ft. 11in.	28 ft. 6 in.	52 ft.	28 ft.	—	31 ft.	18 ft.	46 ft.
Aspect ratio	6·3	5·6	4·9	6·5	6·3	5·2	—	4·35	2·8	5·8
Chassis—*wheels* (W), *runners* (R), *or combined* (C)	R	C	W	W	W	W	W	W	C	C
Covering material—C = *Continental*, F = *Farman*, M = *Michelin*	C	F	C	—	—	C	C	—	—	M
Method of control—W = *warping*, Ai = *ailerons*, Au = *automatic*	W	Ai	Au	Ai	Ai	W	Ai	W	W	Ai
Engine—										
No. of cylinders...	4	4	4	4	8	3	3	7	2	8
Revs. per min.	1400	1200	1000	1300	—	1400	—	1400	—	1100
Horse-power	15	50	50	30	80	25	40	35	30	50
Type of cooling—A = *air*, W = *water*	W	A	W	W	W	A	A	A	W	W
Ignition—M = *magneto*, A = *accumulator*	M	M	M	A	M	A	A	M	M	A
Propellers—										
Number	2	1	1	1	2	1	1	1	1	1
Diameter...	9 ft. 3 in.	8 ft. 6 in.	7 ft. 6 in.	6 ft.	6 ft. 6 in.	6 ft. 10 in.	9 ft. 10 in.	6 ft. 7 in.	6 ft. 6 in.	7 ft. 3 in.
Pitch	—	—	4 ft. 7 in.	—	—	4 ft. 3½ in.	10 ft. 1 in.	—	—	4 ft. 3½ in.
No. of blades	2	2	2	2	2	4	4	4	4	2
Revs. per min.	450	1200	1000	1300	—	1400	500	1400	—	1100
Material—W = *wood*, A = *aluminium*, S = *steel*	W	—	A and S	W	S	A and S	W	A and S	W	—
Drive—C = *chain*, D = *direct* ...	C	D	D	D	C	D	C	D	D	D

the normal flying angle and speed. *If* these conditions are not fulfilled some other force must be introduced to balance the machine.

It follows from the above that if the angle of incidence is decreased the centre of pressure moves forward from the centre of gravity, thus producing a couple which tends to restore the plane to its normal angle. A similar, but reverse action takes place when the angle of incidence is increased, as the centre of pressure then moves in the opposite direction.

The authors are at present experimenting with propellers, but not having yet completed their investigations, they propose to confine themselves to a few general remarks on the subject.

It has taken many years of experience to enable the marine engineer of the present day to design a ship's propeller with comparative success, and it is even now not an uncommon thing to read of a ship being fitted with a new design of propeller in the hope that it may be more efficient than the old one. It seems to be quite evident that the same doubt applies to air propellers, and it is probably on this account that so little information is at present obtainable.

The construction of propellers for aerial purposes cannot be too carefully considered. It is admitted that the high-speed propellers of French design have an efficiency of only 40 per cent., and this is not to be wondered at, considering the method of construction adopted; the large pieces of metal running up the back of the blade are as detrimental to the efficiency of the propeller as a hump along the back of the main plane would be to the efficient lifting power of the plane. On the other hand, we are told that an American-made propeller has an efficiency of 70 per cent. This is built up of wood, the surfaces made smooth and highly polished, thus reducing skin friction and air disturbance to a minimum. Although there are marked differences between the two propellers mentioned, that of American make being of large diameter and run at a comparatively slow speed, while the French design is of small diameter and runs at a high speed, for machines of practically similar size and weight, it may be said that the American propeller is much more suitable for the work.

Considerable weight may be saved by using a small propeller running at a high speed, but it is questionable whether this is really a saving on the efficient running of the machine. In a certain English machine, the method of propulsion is of interest, in that two propellers are fitted, one directly in front of the other, running on the same shaft, and so arranged that they revolve in opposite directions.

Air propellers are usually made with two blades, as it has been found that they are more efficient than if fitted with three or more blades, the reason for this being that the blades follow each other too closely, and their pitch being of necessity small, the disturbance set up by one blade overlaps that due to the following blade, thus reducing the efficient thrust appreciably.

There has been considerable controversy as to the merits or demerits of placing the propeller in front or at the back of the machine, and it remains to be seen which is really the better system. It is fairly evident that the propeller at the back of the machine has a certain advantage, in that it works in the "wake" or following current. Power is spent in producing this forward current, and if the propeller is able to work in this, some of the power is recovered, because the propeller may be said to be working in air more favourable to its efficiency. When the propeller is fitted at the front of the machine, the power expended in producing the wake is all lost, and also that part of the machine directly behind the propeller destroys the effective thrust to a considerable extent.

The authors would like to draw attention to the design of the root of the blades. The blades should be amply strong at the root, as so many serious accidents have occurred through the blades breaking off. The pull at the root $= \dfrac{WV^2}{gr}$,

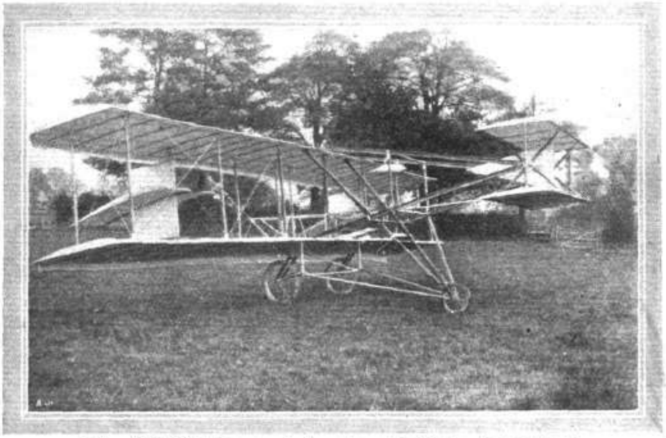
where W = weight of blade,
V = velocity in ft. per sec.,
r = radius in ft.

It may be of interest to know that in a steel propeller with which the authors are at present experimenting, the stress is 26,000 lbs. per sq. in., the propeller being run at a tip velocity of 550 ft. per sec.; and also in the case of a wood propeller, the factor of safety is only 3. In the list of aeroplanes given above will be found particulars of a number of propellers fitted to actual machines.

Control.—The problem of obtaining sufficient effective combination of the necessary surface and power is now overcome to a great extent, owing to the excellence of design and construction, but the greatest problem which has to be faced in nearly all types of aeroplanes is the system of control, for obtaining lateral and longitudinal stability. For lateral stability, the two principal methods of balancing are by total flexing or partial flexing of the main planes, thereby altering the angle of incidence, or by supplementary planes or ailerons.

Of the former, the R.E.P. monoplane and the Wright biplane are the most notable examples; of the latter the Curtiss biplane, which is fitted with two supplementary planes, placed at the extreme ends of and between the main planes, is a good example. The use of hinged edges or tips is common to a number of successful machines. The elevator has also been used to effect this object, but, apparently, not with much success. Longitudinal or phugoid stability is in nearly all cases obtained by an elevator, either in front or at the back of the machine.

The actual steering of the machine is in all cases effected by means of one or more vertical planes placed fore or aft. All the operations for the control of the machine in the air bring up some rather difficult points in mechanical construction; and also it will be evident that, in the control of an aeroplane, there is a third movement, or sense, which does not exist in any other form of locomotion. There is not only the side balance and steering required as, say, in a bicycle, but it is necessary to cultivate a third sense of fore and aft balance. Thus it will be seen that the system of control of an aeroplane must be made as simple as possible, as the sudden gusts and variations of air currents which have to be contended with leave little time for thought on the part of the aviator.


The "C.R." biplane, designed and built by the authors.

The Wright biplane has only two main levers, one at each side of the aviator's seat. On the right is placed the lever, which moves in a fore and aft direction, to operate the elevator, and moves athwartships to move the steering rudder. The other lever is placed on the left hand, and moves in a fore and aft direction to flex the main planes. Wright found that the flexing of main planes was inefficient, as a swerving movement took place due to the drag caused by the end of the main plane which had the greater angle of incidence. To check this and also the action of centripedal force, he added supplementary vertical rudders, which he operated by a lever placed in such a position that it could be readily moved with, and at the same time as, the lever for flexing the main planes. This has been one of the most effectual and simple methods of control so far used.

To obtain automatic stability is naturally the desire of every designer, and will be the only method of control to make the aeroplane a safe and pleasant means of transit. This may be more or less obtained by two methods, viz., (*a*) machines so constructed that they possess automatic stability without movement of main or supplementary planes; (*b*) by mechanical means, either by moving weights, pendulum, vanes, or action due to gyroscopes.

The first method is practised by the Voisin or the cellular class of machine, which rely on a box-like form of construction, but it remains to be proved that this class of machine will be stable under all conditions, because, if certain oscillations are once set up, these oscillations will ultimately capsize the aeroplane. This has undoubtedly been proved by Lanchester's phugoid theory.

Others again rely on a special formation of the main planes themselves, or by setting the planes at a dihedral angle. The setting of the planes at an angle is open to question, because when a certain tilt in the machine is reached, this initial angle tends to increase rather than diminish the instability.

The gyroscope, perhaps, appeals to one as the most feasible and practical device for the purpose. The Marmonier Stabiliser, which is a combination of a pendulum and gyroscope, is the nearest approach to a practical application of this method of obtaining stability, and avoids the disadvantages of either gyroscope or pendulum used separately, as it avoids the brutality of a fixed gyroscope and the continued oscillation of a pendulum.

Constructional Materials.—For main constructional purposes wood is undoubtedly the best material, and should be used as much as possible, on account of its lightness and flexibility. The use of steel or aluminium should be avoided, except for small parts and fittings.

For large members where great strength is required, ash is most suitable. For short beams and spars spruce should be used, and where a very light wood is required, which is not subject to great strain, American whitewood may be employed. Bamboo naturally appeals to one as an ideal material for aeroplane construction, but it has grave disadvantages, in that it is very treacherous and extremely difficult to join up to. Wooden beams and struts can be considerably strengthened by means of binding with fabric and waterproof glue, also very satisfactory hollow spars can be made by this method.

TABLE II.—*Properties of Woods.*

Name of Timber. (Specimens 2 ins. square.)	Transverse Strength. Deflection in ins. Span 6 ft. Load 390 lbs.	Set.	Ultimate Deflection.	Breaking Weight in lbs.	Tensile Strength. Breaking Weight in lbs. per sq. in.	Crushing Strength per sq. in. lbs.	Weight per cub. ft.	Ratios. Tensile Strength to Weight.	Crushing Strength to Weight.
	ins.	ins.	ins.						
English oak ...	2·52	·117	7·71	813	7570	5800	58	130	100
American white ...	1·92	·208	8·83	804	7000	6050	25	280	242
Honduras mahogany	1·916	·083	4·06	802	3000	6270	35	86	179
English ash ...	1·62	·05	8·63	862	3700	6700	52	71	129
Canadian ash ...	2·75	·125	7·47	638	5500	5600	52	106	107
Spruce	1·23	·055	5·19	670	3900	4700	35	111	134
Yellow pine ...	2·12	1·833	4·66	627	2500	4040	42	59·5	96
Bamboo	—	—	—	—	6000	—	19	316	—

The bracing of the machine is usually effected by means of steel piano wire adjusted by tightening screws. Fig. 4 shows a section of a double-covered main plane. The top and bottom strips are generally of spruce, glued and pinned to the front and back edges after having been set to the desired curve by steaming. The transverse beams are of ash, spliced at the joints and strengthened by means of fish-plates. The main struts are made of spruce, and should be of ichthyoid section.

Outriggers are usually made of spruce, cut to an **H** section for lightness.

Considerable weight may be saved in the selection of a good covering material. Excellent qualities of waterproofed canvas are obtainable, in weight varying from $2\frac{1}{2}$ oz. to 4 oz. per square yard, and with a breaking strength as great as 2,000 lbs. per square yard.

Aluminium and steel sheets of about $\frac{1}{100}$ in. and $\frac{2}{1000}$ in. in thickness, respectively, have been used for this purpose. Metal has the advantage of being more easily fixed to the framework, and maintains its curvature better than canvas under pressure.

In Table II is given a list of woods suitable for aeroplane construction.

Chassis.—The chassis is perhaps the most troublesome part of the machine as far as weight is concerned, and requires careful design to keep the weight within reasonable limits, especially where wheels are employed.

One of two methods may be adopted; either skates, which are generally made of curved wood and may be shod with metal, or mounting the machine on wheels arranged on the castor principle and fitted with shock-absorbers. With the former arrangement it is necessary to use a starting device, which necessitates the start being made at a given place only, but a lower-powered engine may be employed than with the second method of mounting the machine on wheels, though with the latter method there is the advantage of being able to start on any suitable ground.

To arrive at the approximate distance in feet required to raise the machine from the ground, the following formula may be used, providing the conditions are favourable :—

$$\frac{W \times V^2 \times v}{2g \times \text{b.h.p.} \times 550 \times E}$$

W = total weight of machine,
V = designed speed of machine in feet per second,
v = mean velocity in feet per second from zero to V,
E = overall efficiency of machine.

The curves in Fig. 8 should be of interest to the aviator, in actual practice, as they show that in starting or landing the machine may be subject to altered conditions owing to variation of the wind velocities.

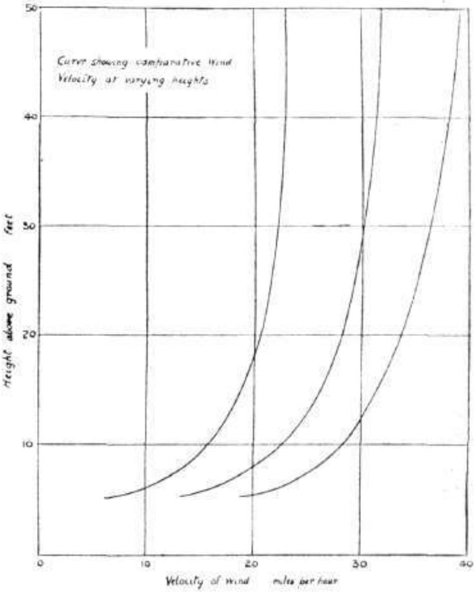


FIG. 8.

The authors have endeavoured to draw attention to a few of the most important points, but have not included the subject of engines, as, although the engine is of vital importance to successful flight, yet it can hardly be said to come under the heading of "the design and construction of aeroplanes." The conquest of the air has been partially accomplished; yet, before it can be said to be completely achieved, it will be necessary to be able to make use of ascending currents and remain poised in mid-air, and accomplish those delicate feats of balance which enable some species of birds to soar in the air without any apparent expenditure of energy.

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Another British-made Aeroplane Fabric.

WE have received from Messrs. Frankenburg and Sons a sample of their British-made aeroplane fabric, with which they are already obtaining a considerable amount of success. The fabric is made of Sea-Island cotton, and is prepared with a rubber face on both sides, or on one side only, as may be required.

With fourteen coats of pure Para rubber on one face only the weight per sq. yd. is 3 ozs. The fabric has a tensile strength of 95 lbs. on a 5 in. strip, and costs *2s. 5d.* per yard run with a width of 36 ins.

GREAT BRITAIN'S POSITION IN AVIATION.

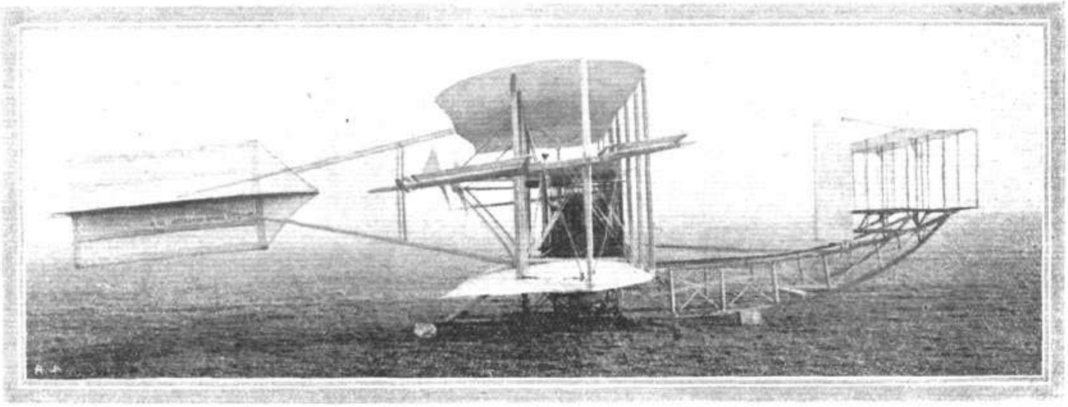
FRANCE is once again playing dog-in-the-manger in auto-propelled matters, and this time it is aviation that is in dispute. In a word, every effort is being made to jockey Great Britain out of the official meetings this year. I hold strongly to the principle that it is a pity, if it can be avoided, for two meetings to clash to the detriment of each other, especially in such a young sport, in which the flyers are comparatively few, and therefore important; and I agree that any meeting which puts up a minimum guarantee of so many thousand pounds, such as the £8,000 agreed upon by the Federation Aéronautique Internationale, should have a certain official preference, as the sounder and more likely to attract the finest aviators, and command the best flying. But at the meeting last week of the F.A.I. it soon became obvious that Great Britain was to be frozen out of this year's fixtures by the French element. In fact, it is not an exaggeration to say that the list was pretty well cut and dried and apportioned by general agreement before Mr. Roger Wallace, the Chairman of the British Aero Club, and Captain Claremont, the other British representative, entered the committee room, shortly afterwards to be invaded by the guarantors, money in hand, eager for their speculation, and clamouring for the best dates. Mr. Roger Wallace quietly, but firmly, held his ground, demanding two dates for Great Britain. France was backed by Italy and Belgium, and allocated four votes to herself, making a total of six. Only a single vote each was allowed to Great Britain and Germany, who sided with Mr. Wallace, as did the Norwegian, Swedish, and Danish vote, which was only one between the three. Russia had no vote at all. Thus, though in the majority so far as countries were concerned, Great Britain lost by six votes to three: but Mr. Wallace still held his ground, and said that the Aero Club of this country would be forced to withdraw from the Federation Internationale unless given fair treatment. In the end the delegates proper withdrew to another room, and eventually yielded to Mr. Roger Wallace's firm attitude. Upon the announcement of this reversal of their decision, the guarantors and speculators, anxious for dates, handed in a hastily-drafted document of protest; but it was decided that it could not be considered, as it was not upon the agenda, and no notice had been given. Thus Mr. Wallace carried his point, and to this country dates were allotted, from July 11th to 17th, and from August 6th to 13th.

The Rights of Great Britain.

No words of commendation can be strong enough for Mr. Roger Wallace's insistence against this country being sacrificed to Gallic jealousy and speculative schemes, but hardly have the British representatives arrived back home before the Commission Aérienne Mixte has decided unanimously only to recognise the first vote given at the meeting of the International Federation, and to ignore the former of the two British dates. There is no doubt that abroad feeling is running high in Parisian aviation circles, but, at the same time, I am sure that the Aero Club over here will never consent to such a barefaced encroachment upon its rights, but will fight such an attempt at suppression in the bold and strong way in which it has at past crises dealt with the situation. If the International Federation had taken the countries in any sort of order, giving France the preference as the pioneer, and allowing each a choice of dates in turn, all would have been well; but, as I have noted above, every date (or almost every available eight days laid down officially as the limit of any individual meeting) was practically allotted between March and November, showing a deliberate attempt to boycott this country. This has been confirmed by subsequent happenings, and now the Aero Club is unquestionably up aganist both the International Federation and the Commission Aérienne Mixte. Whether it withdraws or not is very much a question of their attitude to the Club's intention to go through with its fixtures, regardless of recognition or not; and the feeling is that by next summer there will be sufficient British aviators fully capable of making home meetings successful, to say nothing of intelligent foreigners who will recognise it as worth their while to compete against less formidable opposition for large prizes. As it is, there has been a good deal of talk of an aviators' union to keep up prices as long as possible, but I am sure that they will feel the slump within a few months, whatever happens. Some have gathered in the shekels while they could, and will go on doing so as long as possible; but public interest all over the world will soon fade before a regular series of eight-day meetings.

Flying as a Sport.

Flying is, of itself, too spun out to grip, too monotonous to be spectacular, after the first sensation. Unfortunately for it, too, no modern sport has been born under less favourable auspices in many ways, both of finance and organisation. In its professionalism it is rapacious and insatiable; in its promotion it is often crude and speculative. We shall hold our two big meetings, I am convinced, as the Aero Club is not the body to sit down under such scurvy treatment; but it will not make their success—be it at Bournemouth or Southport—the easier. Unfortunately, it cannot add to our respect for French sportsmanship. We have had experience of it both with reference to the suppression of the Gordon-Bennett and the Grand Prix. It terms itself International, but has only its own irons in the fire, and its jealousy seems principally directed against this country, fearful of our obtaining similar success with the aeroplane to the supremacy we have done with the automobile. We are behind, no doubt, but not so far behind as in the other case, and the strides of the last few months have been enormous. Apart from Mr. Moore-Brabazon and Mr. Rolls, to say nothing of Mr. Cody—now naturalised—we have plenty of promising flyers coming on. Mr. Ferguson, of Belfast, made the first flight in Ireland on New Year's Eve in an Irish-built monoplane. It is spreading throughout our colonies as well. A fortnight ago, at East London, Cape Colony saw its first flight, while on December 9th Mr. Colin Defries —well known in motoring circles in this country a year or two back—made the first flight in Australia on his Wright machine, specially fitted with wheels and suspension of his own design, which give him great satisfaction in the working. I have a letter from him in front of me in which he says that he has been much delayed by the bad weather and strong winds, or he would have been in the air before. Australia is full of enthusiasm, and the interest in flight is extending to the uttermost parts of the earth.—Mr. Gerald Biss in the *Standard*.



Mr. Moore-Brabazon's "No. 5," being his all-British "Short" biplane, in which the most noticeable alteration since we published a photograph of this machine, on October 9th last, is the tail.

The Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

Committee Meeting.

A meeting of the Committee was held on Tuesday, the 25th inst., when there were present :—Mr. Roger W. Wallace, K.C., in the chair, Mr. Ernest C. Bucknall, Col. J. E. Capper, C.B., R.E., Mr. Martin Dale, Professor A. K. Huntington, Mr. V. Ker-Seymer, Mr. J. T. C. Moore-Brabazon, Mr. C. F. Pollock, Hon. C. S. Rolls, Mr. J. Lyons Sampson, Mr. Stanley Spooner, and joint secretaries Capt. E. Claremont, R.N., and Harold E. Perrin.

New Members.—The following new members were elected :—

M. A. Adam, B.Sc.	John Gaunt.
Jeffrey Bennett.	Percy Preston.
Hon. Alan Boyle.	George Reveirs.
A. Norman Dugdale.	John Wilfrid Seddon.
Arthur Eadsforth.	James Valentine.
Charles Evans.	H. S. Wildeblood.
S. W. Fowler-Dixon.	

Library.

Miss M. Nathan has kindly presented to the library the following books :—

"Airships, Past and Present," by A. Hildebrandt.
"Aerodonetics," by Lanchester.
"Aerodynamics," by Lanchester.

The Committee trust that other members will assist with any books of interest.

International Aeronautical Maps.

The Aero Club have appointed Col. J. E. Capper, C.B., R.E., and Professor A. K. Huntington to represent the Club in the preparation of International aeronautical maps.

Aero Exhibition at Olympia.

The full particulars regarding the Model Section will be issued this week, and a supply will be sent to each provincial aero club for distribution amongst its members. Space will be given free, and the Aero Club will erect suitable stands and provide the necessary attendants. In order to partly cover this expense a charge of 10*s.* will be made to each exhibitor, who will be provided with a free pass during the whole exhibition.

Medals will be awarded by the Aero Club and the Aerial League of the British Empire.

Entries and all inquiries must be made to the Aero Club, 166, Piccadilly, London, W.

Members wishing to exhibit full-sized machines are requested to communicate at once with the Aero Club.

Monthly Dinner.

The Monthly Dinner will take place on Tuesday next, February 1st, 1910, at the Hotel Chatham, Regent Street, S.W., at 8 p.m. (5*s.* 6*d.* each). Members wishing to be present are requested to notify the Secretary not later than Monday, the 31st inst. Evening dress optional.

Oxford and Cambridge Graduates.

The Committee of the Aero Club have decided to admit to Membership Undergraduates of the Universities of Oxford and Cambridge at an Annual Subscription of £1 1*s.* during the time they are in residence.

Eastchurch Flying Ground.

The work on the Flying Grounds at Eastchurch is progressing rapidly, and in the course of the next few weeks the whole of the ditches will have been filled up, and the necessary draining completed. The following Members have sheds erected on the grounds :—

Mr. J. T. C. Moore-Brabazon.	Hon. C. S. Rolls.
Mr. Percy Grace.	Hon. Maurice Egerton.
Mr. F. K. McClean.	Major Brocklehurst.
Prof. A. K. Huntington.	Mr. L. Jezzi.

Members wishing to erect sheds are requested to communicate with the Secretary of the Aero Club.

Railway Arrangements.—The following reduced fares have been arranged with the railway company for members visiting Shellbeach :—

1st Class return, 8*s.*; 2nd Class return, 6*s.* 6*d.*; 3rd Class return, 5*s.*

Tickets available for one month from date of issue.

Members desiring to avail themselves of these reduced fares are required to produce vouchers at the booking offices. Vouchers can be obtained from the Secretary of the Aero Club. Trains leave Victoria, Holborn, or St. Paul's.

For the convenience of Members, the best train is the 9.45 a.m. from Victoria, arriving at Queenborough 10.55. At Queenborough change to the Sheppey Light Railway for Eastchurch, which is ½-mile from the flying ground.

E. CLAREMONT, CAPT. R.N.,
HAROLD E. PERRIN,
Joint Secretaries.

166, Piccadilly.

PROGRESS OF FLIGHT ABOUT THE COUNTRY.

(NOTE.—Addresses, temporary or permanent, follow in each case the names of the clubs, where communications of our readers can be addressed direct to the Secretary. We would ask Club Secretaries in future to see that the notes regarding their Clubs reach the Editor of FLIGHT, 44, St. Martin's Lane, London, W.C., by 12 noon on Wednesday at latest.)

Oldham Aero Club (5, CHURCH TERRACE).

THERE was a good attendance of members on the 18th inst., when a paper, dealing with "Aeroplane Propellers," was given by Mr. James Claughton. The subject was dealt with exhaustively, and included several novel points, which aroused much discussion. Several members met on Saturday, 22nd inst., for the purpose of making trial flights with models, although much damage was caused owing to a high wind.

The model of Mr. W. G. Dean made a successful flight of between 60 and 100 yards, taking a perfectly horizontal course.

Oxford University A. and Ae. Club (106, HIGH STREET).

THE Oxford University Automobile and Aero Club are now established in comfortable quarters at the above address, where, in the club rooms, will be found a complete supply of motoring and flying literature. Full particulars regarding the club, of which Mr. K. K. Horn, of Christ Church, is President, can be obtained from the secretary, Mr. C. R. Huggins, of Brasenose.

Mr. Hubert Latham, who is an old student at Balliol, has promised that, if it be in any way possible, he will give an exhibition of flying, under the auspices of the University Club, during the coming spring.

S.W. England Aeronautical Soc. (51, ST. LEONARD'S RD., E. SHEEN)

THE thanks of the club are due to the indefatigable works manager, who attends every evening to superintend the work of erecting the monoplane, with which considerable progress is now being made. The next general meeting will be held on January 30th at the Ship Hotel, Bridge Road, Hammersmith, at 6 p.m. sharp. Members are requested to be punctual.

Yorkshire Aero Club (63, ALBION STREET, LEEDS).

THE committee have decided to hold a "flying" model competition in February (the actual date will be fixed later), to which the public will be admitted, and prospective competitors are asked to send their names in as early as possible. The secretary is arranging for the use of a large covered-in space where members and competitors can make private preliminary trials and tests. Further information can be had from the secretary at headquarters, Corn Exchange, Duncan Street, Leeds, on Tuesdays at 7 to 10, or at 63, Albion Street, Leeds.

MILITARY ASPECT OF DIRIGIBLE BALLOONS AND AEROPLANES.

By COL. CAPPER, R.E.

(*Concluded from page* 61.)

Enemy's Airships.—The third obstacle to the use of the airship is the enemy's airship.

Generally speaking in war, like must be fought with like, and I do not think that airships will prove any exception to the rule.

Seeing the vast importance that reconnaissance by these vessels may be to an army, it is absolutely necessary to prevent the enemy enjoying these advantages whilst retaining them for ourselves.

If my conclusions are correct, terrestrial artillery will be entirely unable to prevent them obtaining most important information. Therefore we must use aerial.

I consider it essential that any serious war-airship should be capable of attacking a similar vessel of the enemy. In any close encounter the destruction of both attacker and attacked may easily be brought about, and though on neither side would the personnel probably shrink from such mutual destruction, it is desirable to avoid it ourselves, whilst ensuring it to the enemy. There is no particular danger in using naked lights (at a distance from the envelope) on any well-made dirigible balloon, the cars of which, whilst remaining light, can easily be made capable of standing the shock of recoil of small guns. A war-airship must, to my mind, carry an armament probably of very special design, with shells similar to the Krupps, so that one hit on the huge envelope of an enemy will prove destructive to it.

To ensure success we must have numbers of such ships sufficient both to destroy the enemy's air fleet, and leave us with a handsome surplus for other purposes, and the victory will go to those who can move the speediest, manœuvre best, and probably highest, and shoot the farthest and straightest.

Offensive Powers of Airships.—There is a second use of airships, which though often exaggerated, we can by no means afford to neglect, and that is their actual offensive use.

Now every large airship has a considerable carrying capacity surplus to the fuel and crew, &c., required even for fairly long voyages, and its armament.

This surplus capacity can be utilised for carrying high explosives.

It is contended by many that it is useless for an airship to carry bombs, as you cannot drop a bomb with any accuracy from any considerable height. But why should such bombs not be fired by compressed air or small charges, so as to start with a fair muzzle velocity? Neither their walls nor the tubes from which they are fired need be heavy, and with practice fair shooting should be made at the small ranges at which they would be used.

At night when airships can keep low down, I am of opinion they could be used with deadly effect on transports, and with considerable power of destruction on bridges, dock gates, arsenals, &c., whilst incendiary bombs may play havoc in supply depôts and stores, and airships so used would cause both moral and material distress to camps, bivouacs and horses, and undoubtedly would harass, by the need for constant watchfulness, posts on the lines of communication and at places far away from the field army.

That the risks to be run by airships so employed would be considerable is undoubted, but I am not disposed to admit that they would be so great that their employment would not be warranted, nor do I think we can afford to neglect the possibility of their use in this manner, nor to guard against it in the only possible way by having a sufficiency of airships ourselves to destroy the whole of the enemy's fleet.

Transport.—Suggestions to utilise airships for transporting troops in any numbers may be looked on as chimerical. At the same time they may have a limited but important utility for the purpose of transporting individuals from point to point where roads are blocked, or ordinary facilities wanting, and it is not inconceivable that an airship at the immediate personal disposal of the Commander-in-Chief might enable him to keep a close and personal view of the distribution of his forces, and the changing incidents of battle, which, with the help of the excellent communication systems now in use, will enable him to recover that direct control over the units of his force which it is now assumed it will be impossible for him to maintain.

Position of Dirigible when at Rest.—I have hardly time to touch upon such questions as to whether a dirigible balloon should be filled at the base and return there almost daily, or be filled in the field, marching with the army and kept there. Whether it should be kept in the open air, either at anchor or fastened to the ground, or whether portable shelters should be carried for it. These are moot points, and besides entailing very considerable questions of transport and personnel, are so dependent on actual experiment that I am not at present able to offer any opinion of value on the subject.

The only point on which I have a decided opinion is that all troops not actually engaged in battle, or hastening to points where their immediate presence is necessary, must be instructed to render any required assistance when called on to do so by the officer in charge of an airship. Circumstances may render it necessary for an airship to come to earth in unforeseen places. Its crew, though ample for its management when in the air, are quite insufficient to manage it on the ground, where it is peculiarly helpless, and failure to render active and immediate assistance may easily result in the total destruction of the ship.

Use of Aeroplanes.—I now pass to the consideration of aeroplanes. The aeroplane as at present evolved is of but little use for war. It can be used for carrying in our own country despatches, maps, &c., with speed and certainty in fair weather; it may even carry single passengers from point to point, but it is not yet useful either for reconnaissance or for offence.

Before many years are passed, however, the story will be a different one, and all the uses to which a dirigible balloon can be at present put can be fulfilled by an aeroplane, with the possible exception that it may prove impracticable to fit it with wireless telegraphy.

Its great speed, however, will enable it to bring back news to a central point without undue delay, and to battle against all but the strongest winds.

It has been objected that, owing to its inability to hover, no useful reconnaissance can be made from it. The objectors, however, neglect to consider two facts:—

1. That when working against the wind its speed, as compared with the stationary earth, is only the difference between its speed through the air and the speed of the wind against it; and

2. That it can circle round a small radius and thus remain practically above one spot for considerable periods.

Invulnerability.—It is extraordinarily invulnerable. The sustaining surfaces may be pierced with many holes without seriously affecting its flight, and some of its main frames may be bruised, or even shattered, without involving its destruction, whilst its small size and high rate of travel will render it a very difficult mark to any artillery.

It, again, must be fought in its own element—the air.

From its cheapness and from the rapidity with which it can be made, it is probable that, if used at all, it will be used in large numbers, and will form a scouting machine of the very first importance.

It may also be used to some extent for the same destructive purposes as a dirigible balloon, the small bombs it can carry, and the absence of mechanical appliances for launching them accurately, being partially compensated for by the largely increased numbers available for any special duty.

Aeroplane *v.* Dirigible Balloon.—A very interesting and important question has to be considered, which is, how far can the aeroplane counteract the dirigible balloon?

The present is undoubtedly to the dirigible balloon, but every airship of existing pattern will, in my opinion, be driven out of the field, before ten years are passed, by the aeroplane.

The height to which present patterns of airships can ascend is limited, and these heights will undoubtedly be reached by aeroplanes. I hesitate, however, to say that an aeroplane will be able to ascend to heights of 10,000 ft. and over, whilst there is no obstacle to designing airships which can go to 15,000 ft. or more. It is merely a question of size.

Within the limits to which aeroplanes can reach, I cannot see how a hostile airship can exist in their presence. They are, as mentioned before, very invulnerable, whilst the airship is peculiarly easily destroyed.

It can never pay an airship to attack an aeroplane; it will always avoid it if possible, and as its speed will probably be considerably less it can only avoid it by keeping above it. An aeroplane can probably not ascend at anything like the pace at which a dirigible can if the latter throws out ballast. Should, however, the aeroplane get above the airship, even at a distance, it can swoop down on it at a terrific pace without much danger, and would have little difficulty in destroying it.

From 20 to 100 aeroplanes can be built for the cost of one dirigible, so the loss of two or three would be no great price to pay for the destruction of an airship, which would not be secure from attack even if it remained close to the ground.

As soon, and the time is close upon us, as the aeroplane shows itself capable of raising two men in any ordinary weather to a height

of 3,000 ft., and of undertaking journeys of 50 to 100 miles with fair certainty, I think that as a mere matter of military precaution we shall be obliged to maintain a very considerable bevy of these vessels, and train large numbers of men to fly and fight them.

Meanwhile, we cannot afford to neglect our dirigible balloons and the study of their improvement, so that until an aeroplane is evolved that will ascend to any height and travel over very long distances without descending we may still be able to enjoy the benefits of aerial strategical reconnaissance and offence at points far beyond reach of our navies and our armies.

No Assistance to Artillery.—I wish to touch on two points, one of which must particularly interest an audience of gunners, and that is the question as to how far these new engines of war will assist the terrestrial artillery.

I fear the answer is "Little, if at all."

At present aerial observation, when used, has proved itself valuable in obtaining targets and in correction of fire, but this assistance is dependent on two essentials :—

1. The observing station must be fairly stationary.
2. It must be in immediate connection with the officer controlling the fire of the guns.

Neither of these conditions is fulfilled by either the dirigible balloon or the aeroplane.

Captive Balloons and Kites.—The second point is how the present captive balloons and kites will be affected.

As an instrument of reconnaissance the use of the dirigible balloon or aeroplane will render the captive balloon unnecessary.

As an observatory for the observation of fire the captive balloon will be of use in the presence of an enemy's dirigibles, which I do not think can harm it. It will, however, be unable to keep the air in the presence of aeroplanes used with dash.

The kites, however, are in a different category. They are at their best in winds in which a dirigible balloon is helpless, and in which an aeroplane may find it hard to manœuvre.

Moreover, they are not easily destroyed by bullets, and an aeroplane would hesitate to charge them for fear of being itself destroyed by the cable.

They might possibly be set on fire, but their uncertain movements would very possibly make an aeroplane chary of coming sufficiently near them to ensure their destruction.

They will, therefore, continue to be of value on windy days both for reconnaissance and for the observation of fire.

Summary.—To sum up, I am strongly of opinion that the limited use of dirigible balloons and aeroplanes with an army may be of the utmost assistance to it for—

1. The collection of intelligence.
2. The moral result on the enemy.
3. The minor destruction of supplies, &c.
4. Assisting the G.O.C.-in-C. to control his troops in battle.

Whilst an extended use of large numbers of these vessels may tend to make warfare more difficult, by the destruction of means of transport, whether on water or on land, and by damage to the factories which supply an army with food, clothing and ammunition, even when situated far in the enemy's country.

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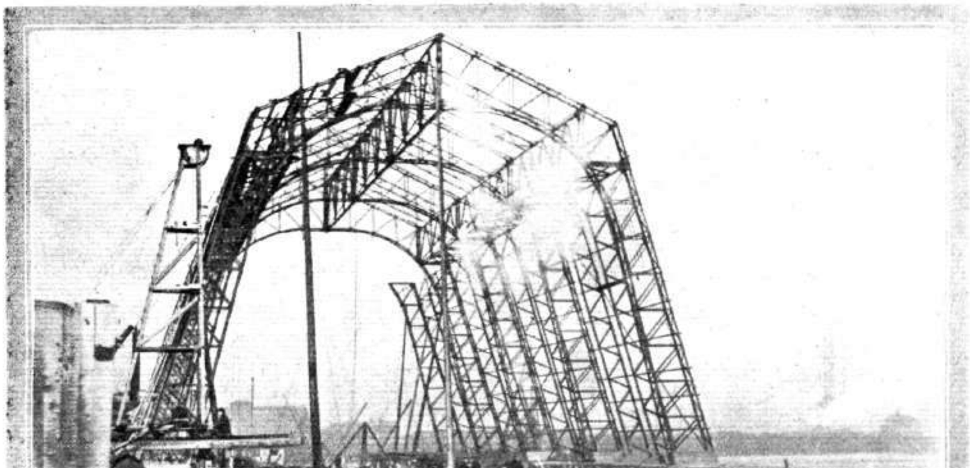
The Los Angeles Meeting.

ON Wednesday of last week M. Paulhan carried Lieut. Beck, of the U.S. Artillery, as a passenger on his Henry Farman, in order that experiments might be made in the dropping of dummy bombs. They were not altogether a success, for each of the "bombs" fell a good many feet wide of the 20 ft. square which formed the target. During these tests M. Paulhan's average altitude was 250 ft. Thursday was the concluding day of the meeting, and the events on the programme were a speed match between Curtiss and Paulhan and an endurance contest. The course for the former was 16 miles, and Curtiss easily proved to be the winner in 23 mins. 43⅗ secs., Paulhan's time being 25 mins. 5⅕ secs. Curtiss retired in the endurance contest, and Paulhan completed the necessary 64 miles in 1h. 49m. 40s. With regard to the prize-money, Paulhan appears to have won the larger share, his winnings being said to be 15,000 dollars, while Curtiss appears to have won only about a third of that sum.



The New Naval Airship Hangar in course of construction by Messrs. Francis Morton at Barrow-in-Furness.—Messrs. Vickers, Sons and Maxim, the builders of the airship, hope to have their vessel ready for trials about the end of February. As already announced, the hangar is being built over Cavendish Dock, the largest single dock in the world. As this is not now in use, there is nothing to interfere with the trials and manœuvring over its surface.

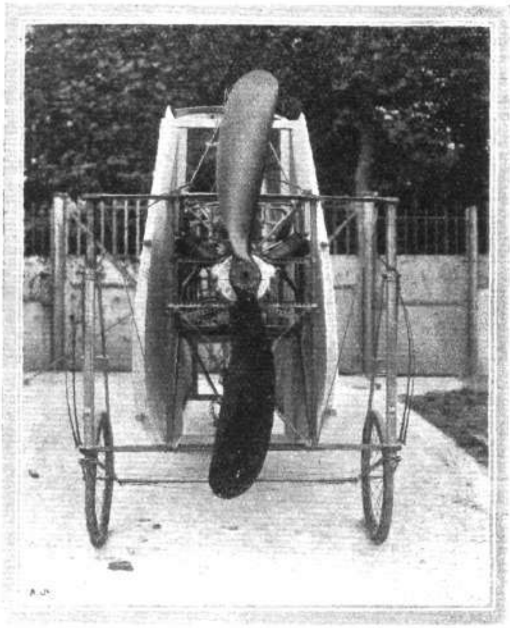
AVIATION NEWS OF THE WEEK.

Mr. Cody Flies Again.

THE time limit for the £1,000 prize for a flight from Liverpool to Manchester expired on Wednesday, and Mr. Cody has waited in vain for a favourable opportunity to make the trip, and secure the prize. On Friday, however, he made a successful short flight at Aintree before packing up his machine preparatory to returning to London. He rose to a height of about 150 ft., and flew above Melling and on to Magshull, and eventually landed in front of the grand stand on Aintree racecourse.

A Flying Ground near London.

ALTHOUGH Mr. Claude Grahame-White's school for flyers at Pau has proved very popular, its distance from London is a great disadvantage, and so arrangements have been made with regard to an extensive tract of land near Hendon, which, when cleared, will, it is thought, form an ideal flying ground, giving a 2-mile circuit. As soon as everything is ready Mr. Grahame-White hopes to transfer the six Blériot monoplanes which are at present at Pau to his new flying ground, and he is also making arrangements to secure two Henry Farman machines. One of his most promising pupils is Miss Spencer Kavanagh, who, under her professional name of Miss Spencer, is well known for her daring parachute flights. One of the latest pupils to join the school is Mr. Armstrong Drexel, son of Mr. Anthony Drexel, the well-known American magnate.



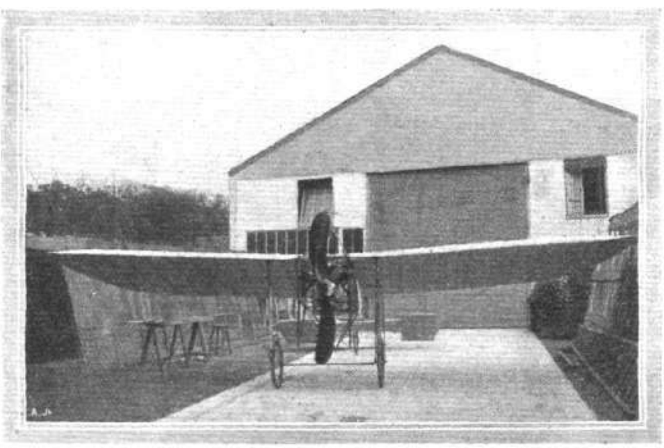
The Blériot monoplane, with its main planes folded up ready for housing or travelling.

A Monoplane at Northampton.

AT their Northampton works, Messrs. Mulliner and Co. at the present time have under construction a monoplane, which will be fitted with a 35-40-h.p. motor. Col. Mulliner and Mr. Gordon Stewart are supervising the work of building the machine.

AeC.F. Official Flying Week.

As was anticipated some time ago, the Aero Club of France have decided to hold their official flying meeting this year at the Croix d'Hins aerodrome, near Bordeaux, and have fixed upon September 9th–18th as the dates.



Under the method of construction of his monoplanes M. Blériot does away with the necessity of huge places for housing them. The main planes can be quite readily folded down to the sides, the whole being brought well within the compass of the main framework. In the above photograph a Blériot is seen with its planes fully set after coming out of its dock, seen behind. In our other photo the same machine is seen folded up.

Van den Born Flies Across Country.

BY flying across country from Buoy to Suippes and back on Sunday last M. Van den Born secured the Paul Buirette prize. The ten miles between the two places were traversed at a good speed, in spite of the fact that a strong wind was blowing, and that snow was falling heavily. Van den Born landed at Suippes, where he was welcomed by the municipal authorities.

Mdlle. Dutrieux Has a Fall.

ON the 21st inst., while Mdlle. Hélène Dutrieux was practising on her Santos-Dumont machine at Issy, she had a somewhat exciting experience, which fortunately ended without injury to herself. The ground was very muddy and heavy, and in her endeavours to get the machine to rise Mdlle. Dutrieux pushed the elevating-lever right over, with the result that the machine shot up very suddenly to a height of ten metres. It flew along for a few minutes, and then as suddenly fell forward, and after striking the earth remained standing perpendicularly. Much to the relief of the terror-stricken onlookers, Mdlle. crawled out from her seat quite unhurt by the fall.

Efimoff Flies for an Hour.

YET another aviator can claim to have flown for more than an hour, for on the 21st inst. M. Efimoff, on his Henry Farman machine, was at Chalons able to keep up for this time, during which he traversed 63 kiloms. During most of the time he flew at a height of about 15 metres.

Olieslaegers Has a Fall.

AFTER his many successes at Oran, Olieslaegers was the victim of an unfortunate mishap on the 20th inst. He was flying at a height of 80 metres when by some means his foot fouled the steering gear. The machine dropped suddenly down to within five metres from the ground, and then came into contact with the telegraph wires, and rebounded on to the railway line, when the monoplane caught fire, and was considerably damaged. Fortunately the aviator escaped with nothing worse than a burn on the face. A public subscription is being got up in Oran to provide the aviator with a new machine.

Sommer Testing.

ALTHOUGH Sommer has not yet made any flights of long duration on the new biplane of his own design, he has made short trial trips of from 10 to 20 minutes almost every day, and has been experimenting with weight carrying. On some of his trials he has carried as much as 150 lbs. of ballast on his machine. It is stated that Baron de Caters has been so impressed with the machine that he has ordered two.

Molon at Havre.

ON the 21st inst. Molon made three flights at Havre, the cumulative distance traversed being 40 kiloms., while he mostly maintained an altitude of about 60 metres.

Another Racing Man Flying.

M. EDMOND, who, it will be remembered, drove a Renault car in several of the big car races, is the latest recruit to the ranks of flyers, he having purchased a Henry Farman machine. As with the majority of Henry Farman's other pupils, M. Edmond's course of instruction was short. At his second attempt by himself he flew 700 metres; this was increased to 4 kilometres at the next lesson, while in the next, twice this distance was covered.

AeC. of France Enters Gordon-Bennett Events.

THE Aero Club of France have already sent to the Aero Club of America entries of full teams of three challengers both for the Gordon-Bennett Balloon Cup and the Gordon-Bennett Flight Cup.

French Army and Aeroplanes.

IN connection with the order for aeroplanes recently placed by the French War Office, Capt. Marie and Lieut. Bellanger, two artillery officers, have been selected to go to Pau to be instructed in the manipulation of Blériot monoplanes. They will be taught to manipulate two machines, one a monoplane of the cross-Channel type, fitted, as usual, with a 25-h.p. Anzani motor, and the other a new model having two seats, both of which are below the main-plane, as in the "No. XII" machine. This will be fitted with a 50-h.p. Gnome engine.

Juvisy Under Water.

FLYING has been out of the question during the past week at Port Aviation, as the flying ground has suffered severely from the recent floods, and the track has been more suitable for motor boat meetings than for flying, the water being several feet deep in parts. One or two aviators fortunately managed to remove their machines to Croix d'Hins before the flood, but those who did not are in a helpless position at present.

Capt. Engelhardt at Work Again.

HAVING recovered from the effects of his accident just before Christmas, Capt. Engelhardt has recommenced his trials with the Wright flyer recently purchased by the German Government. He made several short flights at Johannisthal on the 22nd inst.

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AIRSHIP AND BALLOON NEWS.

"Col. Renard" Ready Again.

AT the beginning of the week the airship "Col. Renard" was re-inflated at Beauval, where the Astra Company have been making some modifications. As soon as the weather is favourable an attempt will be made to pass the five hours' endurance test required by the military authorities before they will take over the vessel.

"Zodiac III" Wins Three Prizes.

THE Aero Club of France have awarded to the "Zodiac III," belonging to Count de la Vaulx, the Meusnier, Giffard, and Dupuy-de-Lôme prizes, provided under the subvention given by the Minister of Public Works. The first, of 4,000 francs, was for the dirigible flying the greatest distance from town to town; the second, of like value, was for the airship which flew the longest distance over a closed circuit; while the third, of 2,000 francs, was for the dirigible of less than 1,500 cubic metres which developed the greatest speed over a 50 kilom. circuit.

Trials with "Gross III."

A SERIES of trials were carried out with the new German dirigible, "Gross III," on the 22nd inst. Rising from Tegel in the morning to a height of 300 metres a series of manœuvres were gone through over Dœberitz, and the airship eventually landed in a snowstorm. In the afternoon the airship again went up and cruised for some time over the Imperial Palace at Berlin, and several times circled above the Brandeburg Gate.

Crossing the Irish Channel.

LAST week Mr. John Dunville took his balloon "Banshee" across to Dublin, with the object of making a trip from there to England, a feat which it is believed has only been successfully performed once previously. Unfortunately, while preparations were being made to ascend on Monday last, the balloon was caught by a sudden gust of wind, with the result that the envelope was badly torn, and caused the abandonment of the project for the time being.

Fate of Andrée Expedition.

THE information which has come from Canada with regard to the finding of a balloon at Reindeer Lake, which it is believed was used by M. Andrée in his ill-fated expedition to the Pole, has induced the Swedish Government to send a mission to the district to inquire into the matter, and see if there is any truth in the report that the explorer was killed by Eskimos.

CORRESPONDENCE.

*** *The name and address of the writer (not necessarily for publication)* MUST *in all cases accompany letters intended for insertion, or containing queries.*

Correspondents asking questions relating to articles which they have read in FLIGHT, would much facilitate our work of reference by kindly indicating the volume and page in their letters.

NOTE.—*Owing to the great mass of valuable and interesting correspondence which we receive, immediate publication is impossible, but each letter will appear practically in sequence and at the earliest possible moment.*

STABILITY OF THE CLARKE GLIDER.

[323] The following corrections of some misprints in the article by me in your issue of January 22nd on the stability of a machine having the small plane (sustainer) in front, will make it more intelligible :—

For "Y" throughout, *read* "γ."

In the penultimate line of the first column, *for* "$\frac{\gamma,}{2}$" *read* "$\frac{\gamma.}{a}$"

In the last line, *before* "also," *insert* "therefore."

In the middle of the second column, *for* "(when $a = \theta$)," *read* "when ($a = 0$)."

For "pertrophied," *read* "hypertrophied."

T. W. K. CLARKE.

MODEL MONOPLANE.

[324] I am making a model monoplane, the main plane is 4 ft. by 10 ins. Could you tell me what the maximum weight should be? also what is the correct angle the planes should be?

Would "J. A." be kind enough to give me details of the principle embodied in his gearless-spring motor for models, as he said he would in your November 27th (No. 48) issue. Thanking both in anticipation.

B'ham. MODELLER.

[325] Enclosed you will find a photo of my machine. The engine is 2¼ ins. bore 2¼ ins. stroke, air-cooled, and weighs only 8 lbs., the cylinder has been turned from solid, the crank-case is aluminium, and has long bronze bearings, the crank is of steel, and connecting-rod is of bronze, the cylinder-head is held down by means of two ¼ in. steel rods, and is ground into cylinder, needing no packing, the head is fitted with both valves, which are 1 in. across, the carburettor is of the surface type, the coil and accumulator are slung to frame behind carburettor, the switch and sparking-levers are on the right-hand side of photo, just above wing, the propeller, which is only an experimental one, is made of wood and is of 2 ft. 6 ins., the wings are adjustable every way, and can be taken off in about half a minute; the machine complete weighs about 25 lbs. The results we have got from it so far are very satisfactory. Since I completed it about three weeks ago we have had very bad weather. I made the machine complete, including patterns for engine, in little over a week. I shortly intend to put on the market similar engines to the above in different sizes. At present I am making patterns for a V-type engine having four cylinders, 4 ins. bore, 4½ ins. stroke. The machine I at present intend to make for this is entirely my own design, and I expect to have it ready for trial early next spring. I shall be pleased to give any further information about the above machine if required. Wishing your paper every success.

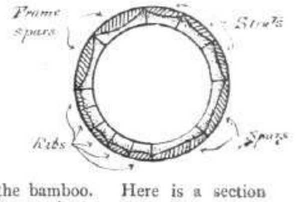
Wigan. W. FAIRHURST, Jun.

TIMBER.

[326] The white Canadian spruce (not silver spruce) is the best wood I am acquainted with for spars. When a better wood than this is found it will be used for the oars in the Oxford and Cambridge boatrace.

For sheer toughness with lightness I commend the choice of willow for small fittings and parts. The cricket-bat makers know.

The difficulty with these woods is they cannot be procured in long lengths. Baltic spruce, the common white deal of commerce, is, perhaps, the most unsuitable wood to put in an aeroplane's framework, but the Canadian variety as used in boatwork, and for oars and sculls, will be hard to beat. It is not easily procured in lengths of more than 12 ft., but is much cheaper than silver spruce. I have had perfect deals and battens of this wood of Messrs. Williams and Sons, Lower Marsh, Lambeth, and it is of those firms who specially cater for yacht and boat builders that the right thing can be got.



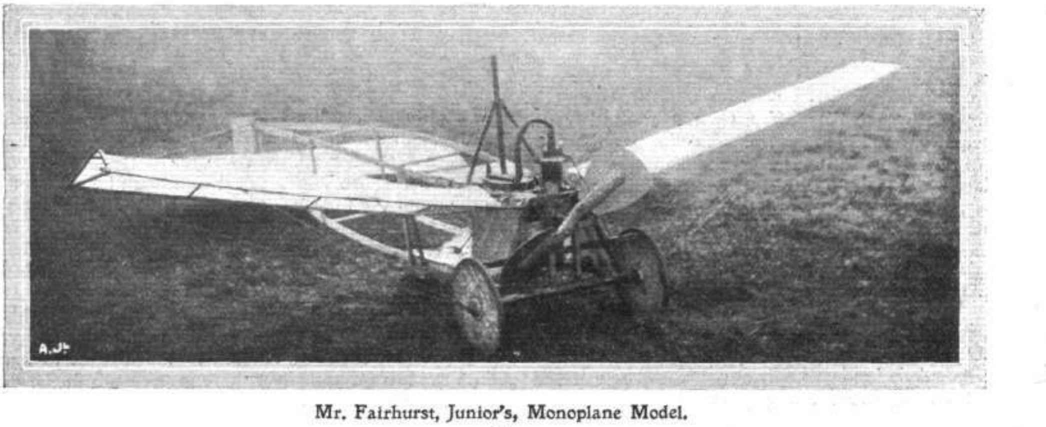
I think the toughest and most elastic material for models' frames is bamboo. The part to use is the slip of tough wood immediately below the flinty surface. The amateur model maker can split it out from the bamboo. Here is a section showing various sizes of strip from one piece.

Nearly all the "wood" for a large model can be got from an odd piece of about this diameter, and twice the length of frame or span of the proposed machine. Japanese fans may be studied by the amateur model maker. Some of these are indeed clever; others would make good wings.

Fawley. T. OSBORN SMITH.

A MODEL BIPLANE.

[327] I enclose a photo of one of our aeroplanes. This particular one, I think, is rather a triplane. The framework is built of fine wood and bamboo. The planes are covered with light fabric. The area of lifting surface is 1,372 sq. ins. The power is obtained by an elastic motor of our own invention—powerful elastic drives a big aluminium wheel (pulley). The propellers are twin aluminium ones; each one has a small aluminium pulley. The big gear drives the two propellers by a single band; one side the band is cross-turned, to drive the propellers in opposite directions; the elastic is fixed to the big gear, which drives it 400. Since the big gear is 12 ins. in circumference, and the small ones 2 ins. in circumference, therefore the propellers revolve $\frac{400 \times 12}{2} = 2{,}400$ revs. The small wheel



Mr. Fairhurst, Junior's, Monoplane Model.

at the side of one of the struts is to work the elevating plane. The peculiarities in this model are the planes which we fixed at the top of the main planes, which give the aeroplane a greater lift at the sides than at the centre, giving lateral stability; also the planes fixed between the main planes are for stability, since one can decrease or increase the angle of incidence to increase or decrease the lift at the side you require. Our photos will clear the matter. Hoping continual success to FLIGHT.

Kensington. MONTOYA BROTHERS (E. AND M.).

PROPELLERS.

[328] In connection with air propellers, there is one point that I do not remember to have seen, which must have a most important bearing on their efficiency. Air is a gas, and is therefore compressible.

To follow the effect of compression, it is simpler in the first instance to take the case of a fixed fan, which is simply rotating about its own axis.

To take a definite case. Maxim, in "Artificial Flight," pages 36 and 37, gives figures relating to an experiment. His propeller was 18 in. diameter and 24 in. pitch; when run at about 2,500 revs. per min. the thrust was 14 lbs. This 14 lbs. thrust represents the reaction or resistance of a volume of air of area approximately equal to the disc area (1·767 sq. ft.) to being set in motion. Neglecting for the moment the front of the propeller, and assuming that the back does all the work, the air immediately behind the area swept by the disc is compressed at an average pressure of 7·9 lbs. per sq. ft. in excess of normal atmospheric pressure of 14·7 lbs.

Now air, within wide limits, is a perfect gas, and providing the temperature remains constant, answers to Boyle's law, $PV = \text{const.}$ As the pressure of the air behind the propeller is increased, its volume must be diminished. Now, no new air has been created by the propeller, consequently the increased density must be balanced by a rarefication of air in another place. There can be no doubt about the position of the rarefied air; it must be in front of the propeller. But if the air is rarefied its pressure must be less than normal (14·7), from which it follows that the 14 lb. thrust represents the difference in pressure between that on the front and on the back sides of the disc area, or, in other words, that both sides of the propeller blades have to be taken into consideration.

A definite weight of air is thrown out by the propeller of a density, d^2, greater than ·076 lb. per cubic ft. (which is density at 14·7 lbs. per sq. in. at 62° Fahr.), at a velocity, V^2. If the temperature remains constant, then the same weight of air must be fed into the propeller, but its density, d^1, is less than d^2, therefore its velocity, V^1, must be greater than V^2. In a well-designed propeller, working at its most efficient speed, it is probable that both sides of the propeller-blades do an equal amount of work. At high pressures per unit area of blade, and consequent high velocity of air current, a propeller might be starved of air, when the pressures could only be maintained by a rise in temperature behind, and a drop in temperature in front of the propeller, and as the efficiency of the propeller depends upon the weight of air acted upon, any energy expended in altering the normal temperature of the air may be written off as lost so far as useful work is concerned.

Between the two sides of the disc area there is an average difference of pressure of 7·9 lbs. per sq. ft. It is, I think, quite clear that the total difference of 14 lbs. represents the difference in pressure between the two sides of the projected blade area.

Maxim's projected blade area is about one-fifth of the disc area, which gives us an average difference of 30·5 lbs. per sq. ft. of projected blade area. What is to prevent this air compressed by the blades from slipping back through the four-fifths of disc area unprotected by blades?

An example will be useful. On a well-designed engine the valve springs will be powerful enough to make the valve lifters or tappets follow the contour of the operating cams at any engine speed. If a valve-spring be taken out the valve will be lifted to its highest point practically the whole of the time, because after it has received one blow by the cam nose its weight is insufficient to overcome its momentum, and it has not had time to drop far before the cam nose comes round again.

The same thing should apply to the air compressed by the propeller blades. Other things being equal, the greater the pressures the greater will be the weight of air which slips back through the spaces between the blades. The weight of air which slips back represents so much lost energy, and this can be diminished by decreasing the pressures; but if we require the same total thrust we shall then require more blade area, but increased area obtained by increased width of blades does not make for efficiency, so that we must increase the length of blades, and consequently the diameter of the propeller.

Now the thrust of a propeller depends upon the weight of air thrown out, and the weight depends upon the velocity—knowing the thrust of Maxim's propeller, we can calculate the velocity of the air current.

Thrust in lbs.

$$= \frac{\text{velocity in ft. per sec.} \times \text{weight of air thrown out per sec.}}{32}$$

Weight of air thrown out per sec.

$$= \text{area of current in sq. ft.} \times \text{weight per cu. ft.} \times \text{velocity};$$

$$\therefore \text{ Velocity} = \sqrt{\frac{32 \times 14}{1{\cdot}767 \times {\cdot}076}} = \text{approx. 58 ft. per sec.};$$

but on Maxim's propeller $\frac{\text{r.p.m.} \times \text{pitch in ft.}}{60} = 83$ ft. per sec.;

which gives a difference of

$83 - 58 = 25$ ft. per sec., or $25 \times 1{\cdot}767 \times {\cdot}076 = 3{\cdot}35$ lbs. of air per sec., which probably represents the amount of air which flowed back through the spaces between the blades. This air would lessen the rarefaction which was trying to exist in front of the propeller, so that in this particular case the positive pressure on the back was much greater than negative pressure on the front of the blades.

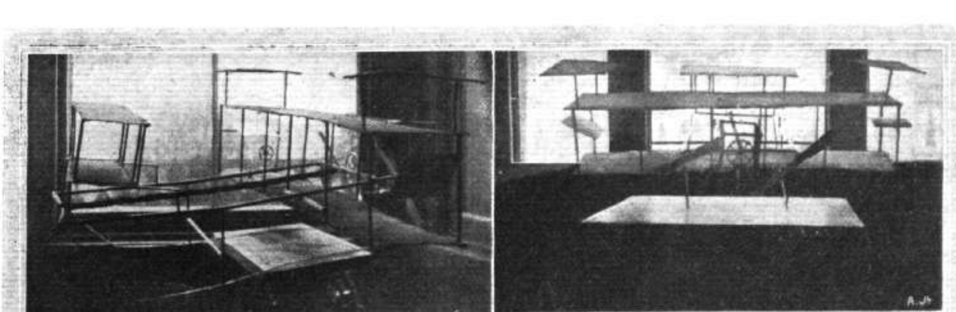
I am not attempting to teach; I have set down my conclusions as they have come upon me, in the hope that someone who is farther ahead may spare a moment to assist those who are plodding along behind.

Bristol. G. H. CHALLENGER.

[329] I thank you for your reply in issue of January 1st to my question as to means of measuring thrust.

As a case in point, I note that in Mr. Twining's book on model aeroplane making the thrust of the 8-inch propeller described is given as 1·1875 ozs. at 2,100 r.p.m. This value to four places of decimals is far more precise than most people would require, and I wish I knew how it is reached.

From your very full reply to my question, for which I am greatly obliged, I understand that the thrust is proportionate to the power of the screw to accelerate air from rest. This brings one up against the question of the number of blades. In ventilating fans, such as the "Blackman," the blades are numerous, so closely set as to overlap, and Davidson's gyropter appears to have screws of this type. But nearly all aeroplanes have only two-bladed screws, only one or two going as far as four blades, and marine practice is similar.



The Brothers E. and M. Montoya Model Biplane.

In the "Encyclopædia Britannica" (article "Screw"), an Admiralty experiment is described, in which a gunboat was fitted with a four-bladed screw, and its performance noted. Then two blades were removed, and it was found that horse-power was saved without loss of thrust. Then why does Blériot use four, and Davidson as many as the boss will hold?

There is a toy consisting of a metal screw with a hollow conical boss, by means of which it can be perched on the end of a steel rod, and violently rotated by pulling off a string wound round the cone. I have made these with varying numbers of blades. With two blades the lift was good and the string-pull easy, also with three; with four the pull required was harder and the flight no better, and by increasing the number of blades, as in a fan or the gyropter, a point was reached at which the thing would not lift at all. Yet a two-bladed screw, made heavy by loading the boss, lifted better than one in which the extra weight was put in in the form of more blades.

It appears to me that some information as to the efficiency of small screws might be obtained on these lines, the screw revolving free in air and exempt from mechanical friction, if the string were of definite length and a pull obtained by the fall of a definite weight. But the two-bladed form must have a rim to give it stability if this form of drive is used. With a stud carrier and multiplying gear, suddenly accelerated and then checked in its motion to release the screw, no rim is required, and it is easy to secure a perfectly vertical flight, but it is hard to be sure of the exact peripheral velocity at the moment of release. I hope to be told of something more convenient than either of these.

Will you kindly tell me what is meant by the expression "gaining pitch"?

Trusting you will not find this too long.

N. Finchley. F. C. HARROP.

[The above interesting letter draws attention to a very important consideration in propeller design, the most efficient number of blades. The sole purpose of a screw is to exert thrust by a rearward acceleration of a column of air. If it can accelerate this column equally well with two blades as when using four blades, there is so much less skin friction to be overcome in forcing the blades themselves through the air. So far as practice goes at the present time, it would seem that two-bladed propellers are very well suited for aerial work, but it must be borne in mind that constructional considerations have considerable weight, and when it comes to making a wooden propeller the two-bladed type is unquestionably the cheapest form. In marine work three-bladed propellers are in common use, mainly, we believe, on the score of good balance. We have not yet seen a three-bladed propeller for aerial work.

The question of testing the efficiency of propellers on the lines suggested in the above letter is one worthy of consideration, although the precise arrangement described is scarcely suited to delicate work.

We have ourselves thought that it might be possible to gain some interesting information by spinning a propeller on a vertical pole, and allowing the propeller to fall under its own weight while spinning. If successful these conditions would convert the blades of the propeller into two aeroplanes gliding down a spiral path, whence the time taken for the fall might be used as a measure of efficiency in the same way that the gliding angle of modern gliders is employed for similar calculations.

With reference to the term "gaining pitch," we should like to know the context in which it occurs.—ED.]

MODELS.

[330] Will any of the models on the market, if suspended by cord, end on, lift their own weight by propeller thrust?

Hall Green. W. VALE.

POINTS TO NOTE.

MESSRS. G. H. SMITH AND W. H. DOREY, LTD., is the title of a new firm which has been established at 14A, Great Marlborough Street, as wholesale aeroplane and motor accessory merchants and agents. Both the principals of the firm are well known by reason of their long connection with the motor trade. The aeroplane catalogue of the firm is promised shortly.

PUBLICATIONS RECEIVED.

Catalogues.

Propellers, Aeroplane Fittings, &c. Cochrane and Co., 26, Clarges Street, W.

All-British Aeroplanes. Howard T. Wright, 110, High Street, Marylebone, W.

Flying Machines, Models, Propellers, &c. The Twining Aeroplane Co., 29B, Grosvenor Road, Hanwell, W.

DIARY OF FORTHCOMING EVENTS.

British Events.

1910.		1910.	
Feb. 4–5 ..	Manchester Ae. C. Model Exhibition.	July 11–17	Flight Meeting, place not fixed.
Mar. 11–19	Flight Exhibition at Olympia.	Aug. 6–13	Flight Meeting, place not fixed.

Foreign Events.

1910.		1910.	
Feb. 6–13..	Heliopolis.	July 14–24	Rheims to Brussels, cross country event.
April 2–10	Biarritz.	July 24–Aug. 10	Belgium.
April 3–10	Cannes.	Aug. 25–Sept. 4	Deauville.
April 10–25	Nice.	Sept. 8–18	Bordeaux.
May 10–16	Berlin.	Sept. 24–Oct. 3	Milan.
May 14–22	Lyons.	Oct. 18–25	America. Gordon-Bennett Balloon Race.
May 20–30	Verona.	Oct. 25–Nov. 2	America. Gordon-Bennett Aeroplane Race.
June 5–12	Vichy.		
June 5–15	Budapest.		
June 18–24	St. Petersburg.		
June 26–July 10	Rheims.		

Aeronautical Patents Published.

Applied for in 1909.

Published January 27th, 1910.

123. A. CLEMENT. Dirigible aerostats.
307. J. T. PICKERSGILL. Aeroplanes.
8,849. F. W. LANCHESTER. Steering of flying machines.
9,525. R. W. ROGERS. Aerial wing machines.

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